

## MAGNETIC SERVO AMPLIFIERS

Types M-5137, M-5178 and M-5179

These amplifiers are designed to drive instrument type two-phase servo motors, controlling the current to both phases, thereby greatly reducing the standby power drawn by equipments employing them.



Airpax magnetic power amplifiers are designed to control both phases of 400 CPS servo motors. In so doing, a 50% standby power reduction is achieved because with no control current the voltage across each phase of the servo motor is reduced to one-half of the maximum output voltage. They can be driven by an Airpax FERRAC® amplifier. Each type is available for operation under military environmental temperature specifications ( $-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ) and for less stringent industrial temperature ranges ( $-5^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$ ). The latter types are characterized by a suffix "R" added to the type number.

A typical application is shown in Figure 1. A servo amplifier, type M-5178, is driven by a FERRAC® pre-amplifier. The power amplifier drives a two-phase servo motor. For maximum output, 6 watts per phase, the servo amplifier requires a 7 milli-ampere DC input signal to either control winding or 3.5 milliamperes DC if both control windings are connected in series. The required input is furnished by the FERRAC® pre-amplifier. Since the combined power gain of the FERRAC® and power amplifier is  $8 \times 10^6$ , the input to the FERRAC® control coils can be extremely low.

Figure 2 illustrates the typical amplifier circuit employing a stabilized lead network.

In Figure 3, stall torque is plotted in ounce/inches for types M-5137, M-5178 and M-5179 as a function of the DC control current, with a 115 volt source.

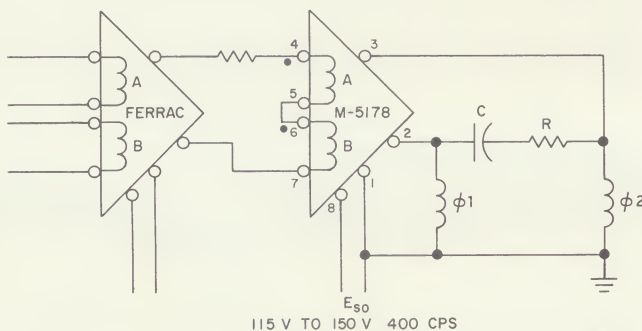
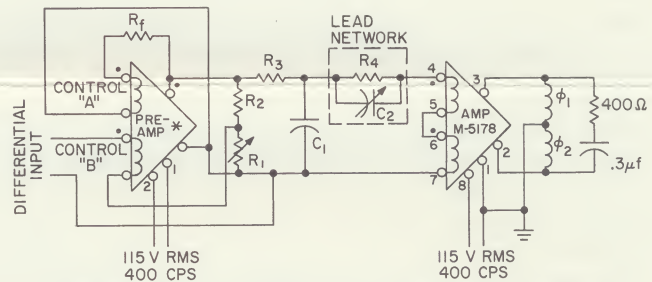


FIGURE 1. AIRPAX POWER AMPLIFIER DRIVEN BY FERRAC®



\*Select from line of FERRACs, typically types M-943, and M-5187.

$R_F = 25 \text{ K}$  for M-943; for other amplifiers, set  $R_F$  numerically equal to the transresistance of auxiliary control winding "B";

$R_2 = 3 \text{ K}$ ;

$R_1$  is variable for gain adjustment. Pre-amplifier voltage gain is approximately equal to  $R_2/R_1$  for ratios less than 200. For  $R_1 = 50 \text{ ohms}$ , a 75 millivolt DC input yields approximately full motor speed for light motor loads;

$C_2$  is optimized for servo system stability, typically 5 to 25  $\mu\text{f}$ ;

$R_4 = 5 \text{ K}$ .  $R_4$  can be decreased to drive the output stage harder.  $C_2$  would be increased correspondingly.

To prevent a decrease in output torque due to pre-amplifier output ripple (fed through  $C_2$ ) the  $R_3 C_1$  filter is required when the lead network is incorporated. Typically,  $R_3 = 100 \text{ ohms}$ ,  $C_1 = 2 \text{ uf}$ .

FIGURE 2. TYPICAL POWER AMPLIFIER CIRCUIT WITH STABILIZING LEAD NETWORK

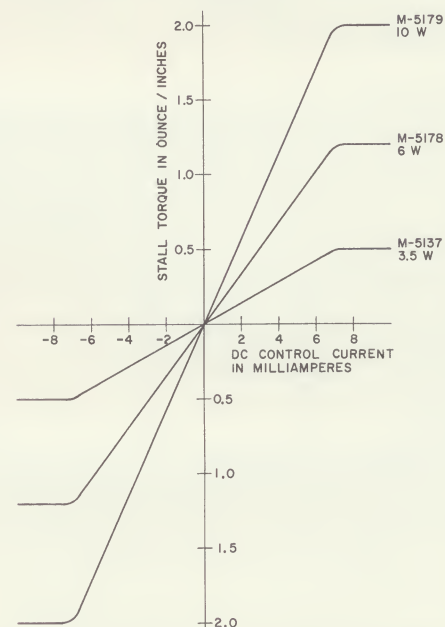


FIGURE 3. STALL TORQUE AS A FUNCTION OF CONTROL CURRENT



## SPECIFICATIONS FOR AIRPAX SERVO AMPLIFIERS

**INPUT:** DC polarity reversible.

**OUTPUT:** AC, phase reversible; 3.5, 6 and 10 watts maximum per phase for types M-5137, M-5178 and M-5179 respectively.

**POWER SUPPLY:** 115 volts  $\pm 10\%$ , 400 CPS  $\pm 5\%$ ; 9.0, 15 and 25 watts maximum at full output for types M-5137, M-5178 and M-5179 respectively.

**STANDARD TEST CONDITIONS:** 115 volts, 400 CPS supply, room temperature.

**AMPLIFIER NULL:** Input current to either control winding to bring the amplifier output to minimum will not exceed 0.07 milliamperes under standard conditions.

**NULL STABILITY:** Input current to either control winding to bring the amplifier output to minimum will not exceed 0.1 milliamperes under  $\pm 10$  volt variations of the power supply at 25 C. At 115 volts, 400 CPS, the input current to either control winding to bring the amplifier output to minimum will not exceed 0.1 milliamperes at any temperature from  $-55$  C to  $+85$  C.

**GAIN STABILITY:** With 1.0 milliamperes input to either control winding at 25 C, the output will not change by more than 10% as the supply voltage is changed from 115 volts by  $\pm 10$  volts. At 115 volts, 400 CPS and 1.0 milliamperes input to either control winding, the output will not change by more than 25% at  $+85$  C, or 40% for types M-5137 and M-5178 and 60% for type M-5179 at  $-55$  C.

**INPUT RESISTANCE:** 68, 205 and 173 ohms  $\pm 25\%$  at room temperature for types M-5137, M-5178 and M-5179 respectively.

**FREQUENCY RESPONSE:** With a 1000 ohm loop resistance in either control winding, the 3 db bandwidth is 6.0, 5.0 and 4.0 CPS minimum for types M-5137, M-5178 and M-5179 respectively.

**TEMPERATURE:**  $-55$  C to  $+85$  C operating  
 $-65$  C to  $+100$  C storage.

**HUMIDITY:** Ten days per MIL-STD-202, Method 106. Satisfactory performance is required after this test; minor blemishes of the finish are acceptable, but severe corrosion is not permitted.

**VIBRATION:** At least 10 G from 10 to 55 CPS in each of three principal axes for one hour in each axis.

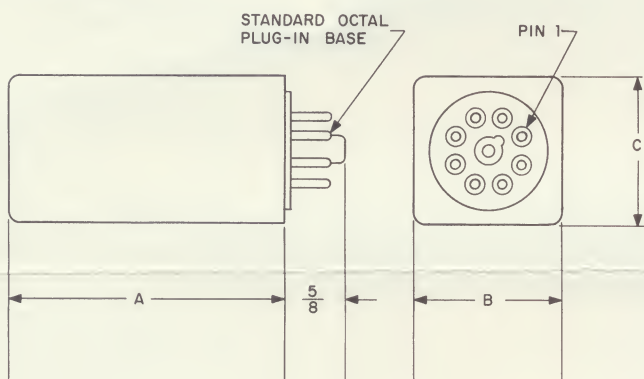
**SHOCK:** 30 G for  $11 \pm$  one millisecond, consisting of three shocks in each direction along each principal axis for a total of 18 shocks.

**INSULATION:** At least 5,000 megohms at 500 volts DC between control windings and between control windings and case.

**ISOLATION:** Input and output are electrically isolated from each other and from the case. One side of the 115 volt line is internally connected to the case.

**MECHANICAL CHARACTERISTICS:** Eight pin plug-in octal socket. Hermetically sealed in a drawn cold-rolled steel case. Finish is black glycerol phthalate base paint per MIL-E-5557, type four, over zinc chromate primer.

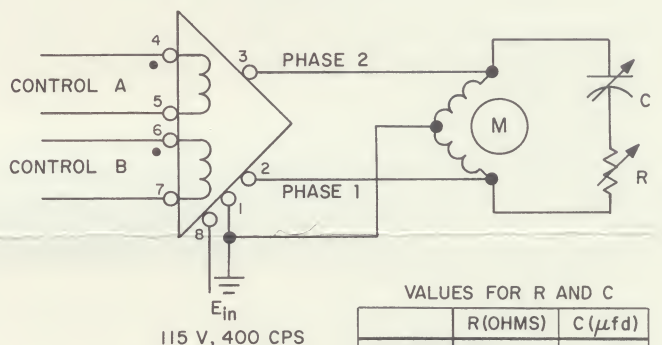
**WEIGHT:** 7.8, 10.8 and 18 ounces for types M-5137, M-5178 and M-5179 respectively.



TYPE	A	B	C
M-5137	$2 \frac{7}{16}$	$1 \frac{15}{32}$	$1 \frac{15}{32}$
M-5178	$2 \frac{15}{16}$	$1 \frac{9}{16}$	$1 \frac{9}{16}$
M-5179	$3 \frac{3}{8}$	$1 \frac{15}{16}$	$1 \frac{15}{16}$

NOTE: ALL DIMENSIONS ARE MAXIMUM

MOUNTING OUTLINE AND DIMENSIONS FOR POWER AMPLIFIERS  
TYPES M-5137, M-5178 AND M-5179



VALUES FOR R AND C

	R(OHMS)	C( $\mu$ f)
M-5137	600, 4W	0.17
M-5178	400, 4W	0.3
M-5179	200, 4W	0.55

NOTES: ADJUST R AND C FOR MAX. TORQUE  
SENSITIVITY FOR SPECIFIC SERVO MOTOR.

POWER CAN BE CONNECTED DIRECTLY  
BETWEEN PIN 8 AND THE JUNCTION OF  
THE TWO MOTOR PHASES

ELECTRICAL CONNECTION DIAGRAM FOR POWER AMPLIFIERS  
TYPES M-5137, M-5178 AND M-5179



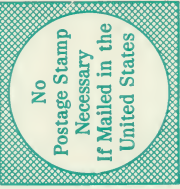
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